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Biology of *Pseudopimpla glabripropodeum* He et Chen (Hymenoptera: Ichneumonidae, Pimplinae) with Description of Final Instar Larva and Redescription of Adults*

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Abstract. *Pseudopimpla glabripropodeum* He et Chen, 1990 was recorded from Japan for the first time and found to be an idiobiont ectoparasitoid of mature larvae of *Hartigia agilis* (Cephidae), a shoot borer of *Rosa multiflora* (Rosaceae). Up to 50% of *H. agilis* larvae were attacked by *P. glabripropodeum* from 1995 to 1997 in Okayama, Honshu, Japan. Description and figures of the final instar larva are given. Adult male and female are redescribed and figured based on Japanese materials. Host and larval cephalic structure of *Pseudopimpla* are discussed. Coloration differences between Chinese and Japanese specimens are referred.

Keywords: Ichneumonidae, *Pseudopimpla glabripropodeum, Hartigia agilis*, Japan, parasitism, final instar larva.

Introduction

The genus *Pseudopimpla* Habermehl, 1917 is a small taxon of the tribe Ephialtini, belonging to the subfamily Pimplinae (Hymenoptera: Ichneumonidae). This genus comprises four species, *Pseudopimpla algerica* Habermehl, 1917 from Algeria, *P. pygidiator* Seyrig, 1927 from the Mediterranean region of southern Europe, *P. glabripropodeum* He et Chen, 1990 and *P. carinata* He & Chen, 1990 from China. Among them, biology and immature stages were studied only on *P. pygidiator* and for this species and *P. carinata* the hosts were reported. Nothing was known on biology, immature stages and host of other species of this genus.

Recently *Pseudopimpla glabripropodeum* was found in Japan, which was originally described from Zhejiang and Hunan, China. This species was found for the first time to parasitize larvae of *Hartigia agilis* (Smith) (Cephidae), boring in shoots of *Rosa multiflora* (Rosaceae). Observations were made on the host, mode of parasitism and the final instar larva, and described here as follows. Redescriptions of adult male and female were made on Japanese specimens.

Materials and Methods

The materials used in this work were collected from three sites, Tsuki and Sôja, in Sôja City, and Funao in Kurashiki City, Okayama Pref., Honshu, Japan from 1995 to 1997 as in Table 1. These sites are in the riverside wasteland along the lower reaches of the Takahashi-gawa River. The vegetation of the observation sites is dominated by *Rosa multiflora* (Rosaceae), *Pueraria lobata* (Poaceae), *Miscanthus sinensis* (Leguminosae). Thickets of *Rosa multiflora* are especially well developed.

The shoot of *Rosa multiflora*, which was attacked by larva of *Hartigia agilis* (Cephidae), can be distinguished by the presence of a boring gallery in the pith of the shoot. When the shoot containing cephid larva is cut transversely, cross section of the brownish boring gallery is found near the center of the pith. The damaged shoots were collected and removed to the laboratory for examination.

Adult materials were obtained by rearing. Cut shoots were contained in plastic bags and stored under indoor conditions, with adults of host and parasitoid

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emerging later, and all emerged adults were examined for description of adult morphology. The materials used for description of larva were collected on June 10, 1997 at Sôja.

The external structures were observed under a stereoscopic microscope. A scanning electron microscope (JOEL CO., JSM-35) was used for detailed observation.

For the observation of larval cephalic structure, heads of final instar larvae killed in hot water, were removed and treated with 10% KOH solution for about 24 hours at 25℃, then transferred into 3% CH_3COOH, and washed in distilled water. The treated head capsules were stained with Delafield's Hematoxylin and observed in pure glycerol under a stereoscopic microscope. Male genitalia were prepared by the method of Konishi (1985).

Terminology of larval cephalic structures follows Finlayson (1975) and Short (1978), and for adult morphology that of Townes (1969).

Materials used in this study are deposited in the collection of the Biosystematics Laboratory, Graduate School of Social and Cultural Studies, Kyushu University (BLKU) and Osaka Museum of Natural History (OMNH).

Life history

Host

The host of *P. glabripropodeum* is a cephid sawfly, *Hartigia agilis*. Larva of *P. glabripropodeum* was observed (May 22, 1997) to consume mature larva of *Hartigia agilis* in the shoot of *Rosa multiflora* in two cases. In other shoots containing *Pseudopimpla* larva, fragments of cephalic sclerites of the larva of *Hartigia* and its horntail, which is characteristic for cephid larvae, were scattered around the parasitoid larva.

Mode of parasitism

P. glabripropodeum is a solitary idiobiont ectoparasitoid. Female of this species oviposits a single egg per host, the larva hatches and consumes the host externally.

The larva of *Hartigia agilis* bores toward the apex of the shoot, and after maturity retraces for a few centimeters. The mature larva forms a chamber for pupation, which is slightly broader than the boring gallery, where it spins a cocoon. Because the cephid larva, which was to be consumed by the parasitoid, showed no response to external mechanical stimuli, it is assumed that it had been paralyzed or killed when the parasitoid egg was oviposited. The host larva, parasitized by *P. glabripropodeum*, was always in a pupal chamber as far as observed. The cocoon of *P. glabripropodeum* was usually found inside the cocoon of its host as Bruzzese (1982) reported in *P. pygidiator* Seyrig.

The parasitoid hibernated as prepupa and did not pupate until March. In late March adults of host started to emerge first, followed 5–10 days later by adults of *P. glabripropodeum* under the indoor conditions. The adult of *P. glabripropodeum* emerged by chewing a hole through the stem.

Parasitism by Pseudopimpla glabripropodeum *on* Hartigia agilis *in Okayama*

The results of examination of *Rosa multiflora* shoots collected by the above-mentioned methods from 1995 to 1997 are shown in Table 1. *Pseudopimpla glabripropodeum* attacked nearly 50 % of the larvae of *Hartigia agilis*. Some *H. agilis* were parasitized by a species of unidentified gregarious eulophid, while the cause of death of others could not be determined.

Description

Final instar larva (Fig. 1A–E).

Body length 8.0–9.5 mm. Milky white in color. Body (Fig. 1 D & E) 13–segmented, cylindrical, cuticule of thoracic and abdominal segments entirely cov-

Table 1. Parasitism by parasitoids on *H. agilis* in Okayama Pref. from 1995 to 1997.

Site	Date	Host			Parasitoid	
		H. agilis			*P. glabripropodeum*	Eulophidae
		examined	healthy	dead*	No. (%)	No. (%)
Tsuki	March 17, 1995	51	20	5	24 (47.1)	2 (3.9)
Tsuki	March 25, 1996	31	17	—	12 (38.7)	2 (6.5)
Tsuki	January 2, 1997	15	8	1	4 (26.7)	2 (13.3)
Funao	March 22, 1997	26	6	6	14 (53.8)	—
Tsuki	June 9, 1997	6	5	—	1 (16.7)	—
Sôja	June 10, 1997	44	16	1	22 (50.0)	5 (11.4)

* cause of death undetermined

ered with dense minute spines, weakly tapered posteriorly beyond 2/3 of the body, with pair of subspiracular tubercles on 1st to 12th segments, those on 12th indistinct, and with dorsal transverse tubercle on 3rd to 11th; first thoracic segment and 1st to 8th abdominal segments with brownish spiracles; the diameter of atrium is 3.0× as long as that of closing apparatus basally (Fig. 1C); cephalic sclerites (Fig. 1 B) reddish brown; pleurostoma (ps), hypostoma (hs), spar of hypostoma (hsp), stipital sclerite (ss), anterior pleurostomal process (ap), posterior pleurostomal process (pp), mandible (m) and labial sclerite (lbs) well sclerotized; antenna (a), labral sclerite (lms) and epistoma (e) weakly sclerotized; mandible strongly tapered near middle, with row of teeth apically; lower margin of labial sclerite strongly produced ventrally.

Female (Fig. 2A–D)

Head: Flagellum 37–40-segmented; 2nd flagellar segment 2.3–2.5× as long as apical width, 1.6× as long as the 1st. Clypeus 1.7× as wide as long, apical margin bilobed and slightly reflexed; supra-clypeal area roundly convex, 1.1× as wide as long, finely and densely punctate, covered with rather dense setae; supra-antennal area, vertex, occiput and gena shining, impunctate to very finely punctate; dorsomedial portion of occipital carina (Fig. 2A) incomplete for short distance, decurved to foramen magnum.

Mesosoma: Pronotum smooth and shining laterally, anterior margin strongly ridged, with triangular posterodorsal raised area connected to anterior transverse ridge by median longitudinal ridge; epomia strong to dorsal margin. Mesoscutum 1.3× as long as wide, finely and densely punctate on whole surface, covered with dense short setae; notaulus distinct to half of mesoscutum; scutellum and postscutellum weakly convex. Mesopleuron and mesosternum smooth and shining; prepectal carina sinuate not reaching to dorsal and anterior margins; sternaulus sinuate, distinct from prepectal carina to base of hind coxa; metapleuron smooth and shining. Propodeum (Fig. 2 B) convex, finely punctate anterolaterally, with large pentagonal area which is nearly impunctate, lacking setae posteromedially; pair of median longitudinal carinae present at base but very short; propodeal spiracle elliptic.

Legs: Front and middle femora inflated, front tibia with some bristles on anterior side; front basitarsus 5.2× as long as apical thickness; hind femur 4.4× as long as thick in lateral view; hind tibia stout, 2.8× as

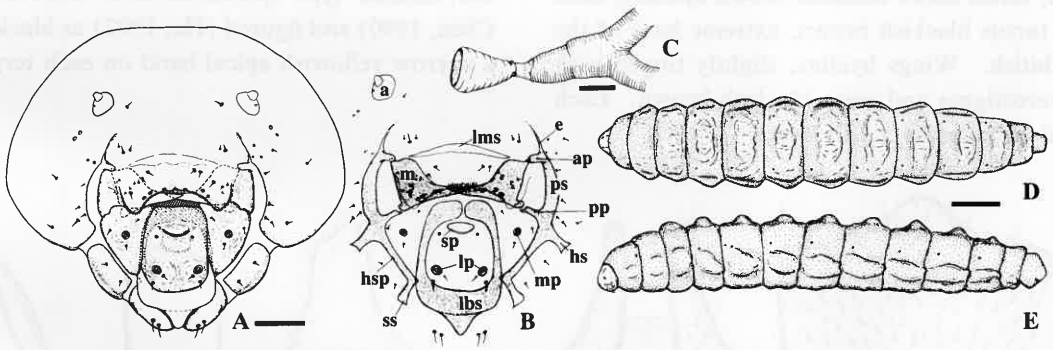

Fig. 1. Final instar larva of *Pseudopimpla glabripropodeum*. A: Head, frontal aspect. B: Cephalic sclerites. C: Spiracle, lateral aspect. D: Habitus, dorsal aspect. E: Ditto, lateral aspect. Scales: 0.1 mm for A, 0.02 mm for C, 1.0 mm for D–E.

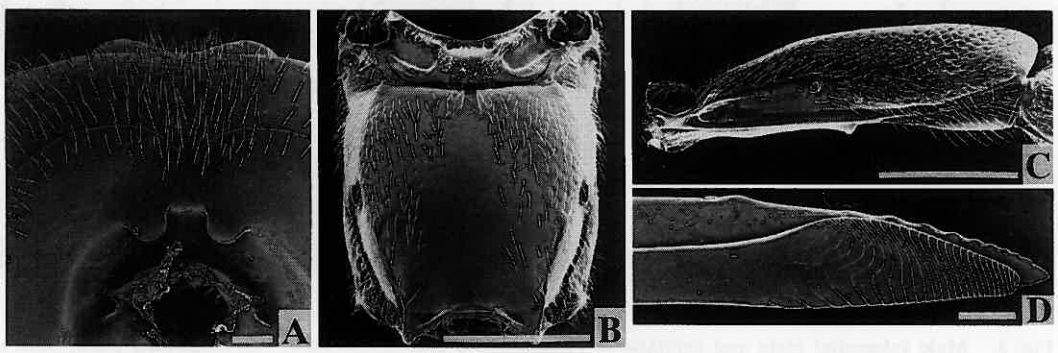

Fig. 2. Adult female of *Pseudopimpla glabripropodeum*. A: Occiput, posterior aspect. B: Propodeum, dorsal aspect. C: T1, lateral aspect. D: Ovipositor tip, lateral aspect. Scales: 0.1 mm for A & D, 0.5 mm for B & C.

long as its apical thickness; tarsal claws of all legs with large basal lobe.

Wings: Forewing with 1cu-a opposite M; areolet almost triangular with very short stalk above, receiving 2m-cu little basad of distal corner; hind wing with abscissa of Cu between M and cu-a, 0.3× as long as cu-a, and abscissa of Cu between M and cu-a angled more than 90° with cu-a.

Metasoma: Metasomal terga moderately and densely punctate; T1 triangular, 1.8× as long as apical width in dorsal view, slightly convex in lateral view, with short dorsal carina and lateral carinae, the latter distinct from base of T1 to spiracle (Fig. 2C); T2 0.7 × as long as apical width; ovipositor (Fig. 2D) strongly compressed, slightly decurved, 0.8× as long as hind tibia; tip of upper valve with ripple-like teeth dorsally; tip of lower valve with dorsal lobe, which encloses upper valve, with many nearly vertical teeth set are close to each other.

Coloration: Blackish brown to black. Scape and flagellum brown to yellowish brown. Inner orbit, clypeus, basal portion of mandible and ventral portion of gena pale brown. Dorsolateral margin of pronotum, tegula, subtegular ridge, scutellum and postscutellum marked with yellow. Legs yellow to yellowish brown, tarsal claws blackish brown apically; hind tibia and tarsus blackish brown, extreme base of the former whitish. Wings hyaline, slightly tinged with brown; pterostigma and veins blackish brown. Each metasomal terga without pale band.

Lengths. Body 8.2–11.8 mm; forewing 6.1–8.9 mm; ovipositor sheath 1.5–2.0 mm.

Male

Similar to female except as follows: Flagellum 36–42-segmented; supra-clypeal area and clypeus entirely yellow; legs paler than in female. Genitalia as Fig. 3A–E; subgenital plate (Fig. 3A) quadrate, bearing rather dense setae; apical margin produced medially; paramere (Fig. 3B–C) narrowed apically, moderately pointed, and bearing dense setae on outer side apically; apex of distivolsella rough, without setae; gonolacinia slightly turned outward; aedeagus (Fig. 3D–E) stout and flat, slightly upturned, apically rounded in dorsal view.

Lengths. Body 7.8–11.0 mm; forewing 5.0–7.3 mm.

Remarks

Although Japanese specimens of *Pseudopimpla* examined in this study well matched the original description of *P. glabripropodeum* based on Chinese specimens, there were slight differences in adult coloration. The metasomal terga are uniformly brown to blackish brown and without a yellowish apical band in Japanese specimens. In contrast, the metasomal terga of the Chinese type specimens were described (He & Chen, 1990) and figured (He, 1992) as black and with a narrow yellowish apical band on each tergum.

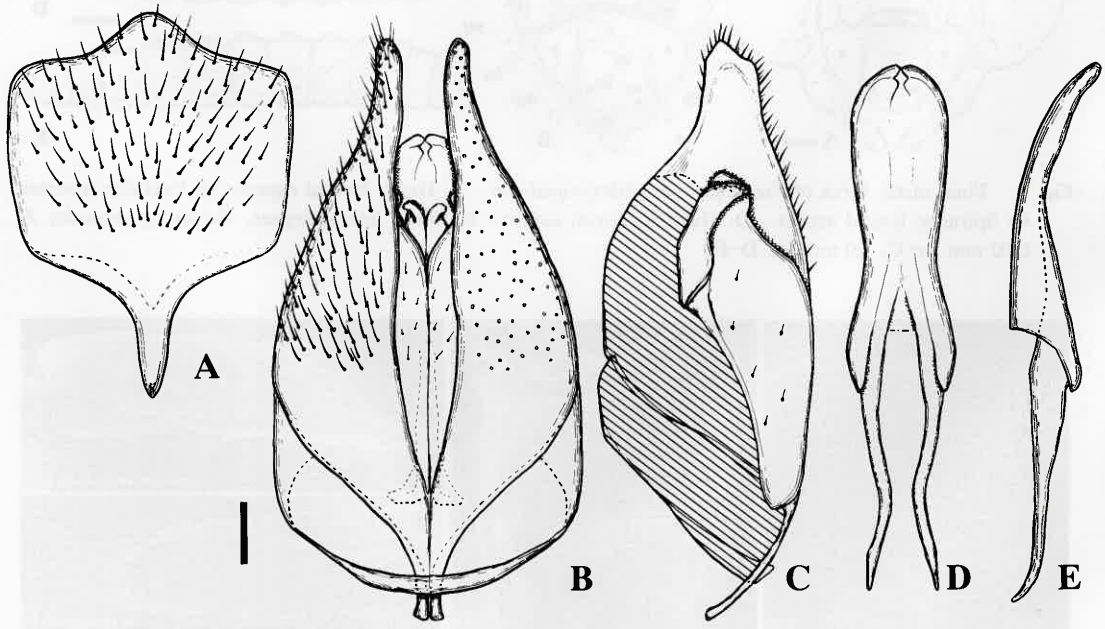

Fig. 3. Male subgenital plate and genitalia of *Pseudopimpla glabripropodeum*. A: subgenital plate, ventral aspect. B: Genitalia, ventral aspect. C: Right paramere, inner aspect. D: Aedeagus, ventral aspect. E: Ditto, lateral aspect. Scale: 0.1 mm.

Discussion

Host of the genus Pseudopimpla

The European species, *P. pygidiator* is known to attack a cephid sawfly, *Hartigia albomaculatus* (Stein) boring in *Rubus fruticosus* (Linnaeus. agg.) (Bruzzese, 1982), and *Janus compressus* (Fabricius) (Scaramozzino & Currado, 1984). The life cycle of *P. pygidiator* is well synchronized with that of its host, *H. albomaculatus*, (Bruzzese, 1982). He & Chen (1990) listed a cephid larva and a pyralid larva in an oak twig as host of *P. carinata*. In Japan, *P. glabripropodeum* is reared only from *H. agilis*. Thus the species of *Pseudopimpla* primarily associated with cephid sawflies. It may also associated with lepidopterous borers in habitats similar to cephid one.

Wahl & Gauld (1998) showed a cladogram of Pimpliformes, and discussed on evolutionary patterns of biological traits in the Pimpliformes. They supposed that the utilization of hymenopterous hosts in Pimplinae is plesiomorphic. They also stated "several members of apparently basal genera [of Ephialtini], such as *Scambus* and Townesia, also attack Hymenoptera", and "it is only the terminal lineages of Ephialtini and Pimplini that diversified to exploit a very much wider range of host". Therefore the association with cephid host in the genus *Pseudopimpla* seems to be a plesiomorphic state of host utilization in Ephialtini, although the phylogenetic relationships among genera of Ephialtini are far from established.

Larval cephalic structure of the genus Pseudopimpla

Townes (1969) divided the tribe Ephialtini into four genus-groups, *Ephialtes* gp., *Alophosternum* gp., *Pseudopimpla* gp. and *Camptotypus* gp. on the basis of adult morphology. He distinguished the genus *Pseudopimpla* by the heavily sclerotized hypopygium, the relatively short compressed ovipositor whose lower valve has the dorsal lobe which encloses tip of upper valve, and the circular to pentagonal impunctate area on dorsal face of Propodeum.

Short (1978) described the larval cephalic structures of nine genera of the *Ephialtes* gp. and *Alophosternum* Cushman, the only member of *Alophosternum* gp. Scaramozzino & Currado (1984) described and figured the larval cephalic structure of *P. pygidiator.*

Among the genera of Ephialtini, whose larvae are known, the larva of *P. glabripropodeum* is characterized in having the lower margin of the labial sclerite acutely produced medioventrally and the hypostoma not enlarged medially. These features were also pointed out by Scaramozzino & Currado (1984) from *P. pygidiator*. The medioventrally produced labial sclerite has not been found in any other genera of Ephialtini. This larval character distinguishes *Pseudopimpla* well as the above-mentioned adult ones.

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